

**United States Patent** [19]  
**Yamazaki et al.**

[11] **Patent Number:** 6,071,766  
[45] **Date of Patent:** Jun. 6, 2000

[54] **METHOD FOR FABRICATING SEMICONDUCTOR THIN FILM**

[75] **Inventors:** Shunpei Yamazaki, Tokyo; Hisashi Ohtani, Kanagawa; Akiharu Miyanaga, Kanagawa; Satoshi Teramoto, Kanagawa, all of Japan  
[73] **Assignee:** Semiconductor Energy Laboratory Co., Ltd., Kanagawa-ken, Japan

[21] **Appl. No.:** 09/115,838  
[22] **Filed:** Jul. 15, 1998

**Related U.S. Application Data**

[62] Division of application No. 08/536,977, Sep. 29, 1995, Pat. No. 5,789,284.

[30] **Foreign Application Priority Data**

Sep. 29, 1994 [JP] Japan ..... 6-259117

[51] **Int. Cl.<sup>7</sup>** ..... H01L 21/00  
[52] **U.S. Cl.** ..... 438/166; 438/407; 438/476  
[58] **Field of Search** ..... 438/166, 402, 438/476, 150, 151, 152

[56] **References Cited**

**U.S. PATENT DOCUMENTS**

4,561,171	12/1985	Schlosser	437/10
5,147,826	9/1992	Liu et al.	437/233
5,229,306	7/1993	Lindberg	437/12
5,244,819	9/1993	Yue	437/11
5,275,851	1/1994	Fonash et al.	427/578
5,441,899	8/1995	Nakai	438/766
5,444,001	8/1995	Tokuyama	437/10
5,529,937	6/1996	Zhang	437/10
5,696,011	12/1997	Yamazaki et al.	437/40
5,796,116	8/1998	Nakata et al.	257/66
5,828,429	10/1998	Takemura	349/42
5,899,709	5/1999	Yamazaki et al.	438/151

**le;5qFOREIGN PATENT DOCUMENTS**

3-229415 10/1991 Japan .  
6-333824 12/1994 Japan .

**OTHER PUBLICATIONS**

C. Hayzelden et al., "In Situ Transmission Electron Microscopy Studies of Silicide-Mediated Crystallization of Amorphous Silicon" (3 pages), date unknown.  
A.V. Dvurechenskii et al., "Transport Phenomena in Amorphous Silicon Doped by Ion Implantation of 3d Metals", Adademikian Lavrentev Prospekt 13, 630090 Novosibirsk 90, USSR, pp. 635-640, date unknown.  
T. Hempel et al., "Needle-Like Crystallization of Ni Doped Amorphous Silicon Thin Films", Solid State Communications, vol. 85, No. 11, pp. 921-924, 1993.  
R. Kakkad et al., "Crystallized Si Films by Low-Temperature Rapid Thermal Annealing of Amorphous Silicon", J. Appl. Phys., 65(5), Mar. 1, 1989, pp. 2069-2072.  
G. Liu et al., "Polycrystalline Silicon Thin Film Transistors on Corning 7059 Glass Substrates Using Short Time, Low-Temperature Processing", Appl. Phys. Lett. 62(20), May 17, 1993, pp. 2554-2556.  
G. Liu et al., "Selective Area Crystallization of Amorphous Silicon Films by Low-Temperature Rapid Thermal Annealing", Appl. Phys. Lett. 55(7), Aug. 14, 1989, pp. 660-662.  
R. Kakkad et al., "Low Temperature Selective Crystallization of Amorphous Silicon", Journal of Non-Crystalline Solids, 115, 1989, pp. 66-68.

*Primary Examiner*—Richard Elms

*Assistant Examiner*—Michael S. Lebentritt

*Attorney, Agent, or Firm*—Eric J. Robinson; Nixon Peabody LLP

[57] **ABSTRACT**

An object of the present invention is to provide a technology of reducing a nickel element in the silicon film which is crystallized by using nickel. An extremely small amount of nickel is introduced into an amorphous silicon film which is formed on the glass substrate. Then this amorphous silicon film is crystallized by heating. At this time, the nickel element remains in the crystallized silicon film. Then an amorphous silicon film is formed on the surface of the silicon film crystallized with the action of nickel. Then the amorphous silicon film is further heat treated. By carrying out this heat treatment, the nickel element is dispersed from the crystallized silicon film into the amorphous silicon film with the result that the nickel density in the crystallized silicon film is lowered.

6 Claims, 9 Drawing Sheets

**IMPURITY ION IMPLANTATION AND LASER LIGHT IRRADIATION**

